

# A nuisance diatom species: *Didymosphenia geminata* in western streams

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## INTRODUCTION

Historically, the diatom *Didymosphenia geminata* (Lyngbye) Schmidt (Fig. 1) was restricted to oligotrophic lakes and flowing waters of northern latitudes of North America, Europe, and Asia. In recent years, its distribution has changed. *Didymosphenia geminata* not only appears to be expanding its geographic range to the south, but it increasingly forms thick and extensive masses that persist throughout the year (Sherbot & Bothwell 1993, Jonsson et al. 2000, Kawecka & Sanecki 2003, Holderman & Hardy 2004). Thickness of the growths can be over 10 cm, covering up to 90% of the stream substrate over several kilometers of stream reach, as in Rapid Creek in the Black Hills of South Dakota. This species was recently found in large growths in a watershed in New Zealand (Kilroy 2004), illustrating its capacity to invade habitats outside its historic geographic range.

## PROBLEM

In 2004, we noticed that sites sampled for periphyton under the Western Environmental Monitoring and Assessment Program (EMAP) showed an unusually high abundance of *D. geminata*. Although historic records are scarce, it appeared that this diatom had expanded within streams and across watershed boundaries. Our objective within EMAP is interpret the biotic condition of western streams, and in order to make an accurate interpretation, we need to consider the recent invasive behavior of this species in both a local and regional context.

### Is the proliferation of *D. geminata* in the Northern Hemisphere of concern?

The ecological impact of this species has not been evaluated, and there are reasons why *D. geminata* may be of concern:

- large diatom cells represent significant biomass in streams
- cells produce massive mucopolysaccharide stalks, much greater biovolume than biovolume of living cells
- stalks appear to be resistant to grazing by invertebrates
- stalks appear to be relatively resistant to decomposition
- stalks persist beyond the death of cells and trap fine sediment

## RESULTS

*Didymosphenia geminata* was first reported growing in large abundance in Rapid Creek in 2002. In April 2005, *D. geminata* was found in low abundance above Pactola Reservoir, reaching its greatest substrate coverage (96%) at SDRAP13 near the community of Hiseiga (Figs 5,9). The thickness of the stalked diatom mats ranged from 0.5 cm to 10 cm at SDRAP13. Figure 4 shows a rock covered by *D. geminata*, with a thickness of up to 1.0 cm.

Populations of brown trout have been estimated in Rapid Creek for the years 1998-2002 and 2004 (Fig. 8). Comparing the mean values for 1998-2002 and 2004, the number of adult fish has decreased at all sites, with the largest declines at SDRAP16 and SDRAP17. Although the number of adult fish have declined, the number of juveniles (length < 200 mm) has increased.

## FURTHER WORK

*Didymosphenia geminata* is increasingly reported in large masses in streams and rivers of the Northern Hemisphere. We propose that the proliferation of *D. geminata* is mediated by

- 1) low, stable flow caused by drought, 2) stable flow in regulated rivers, 3) increased dispersal aided by human activities, 4) increased flux of UV-B, which impacts organisms at differentially.

This diatom produces an unusually massive amount of organic material in streams. In Rapid Creek, brown trout have declined in recent years. However, the association with the increase in *D. geminata* remains correlative, and other sites in the west have not reported impacts to fish populations. Preliminary data from this study and others suggests that excessive growths of the diatom are associated with declines in abundance of some invertebrate species.

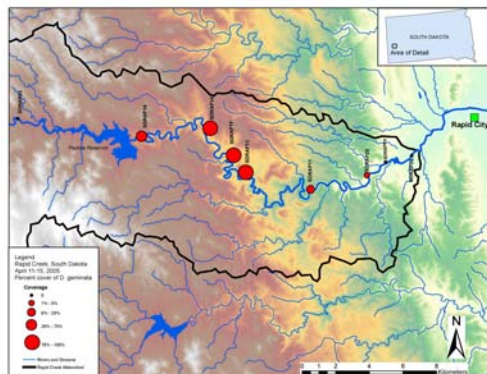


Figure 9. Map of a portion of Rapid Creek Watershed, showing sample sites. During the week of April 11-15, 2005 percent cover of *D. geminata* was estimated at several sites. Values ranged from 0-95 % cover, with the greatest cover at SDRAP13 (Hiseiga). Samples for water chemistry and macroinvertebrates (following EMAP protocol) were collected at SDRAP13 and SDRAP23. Additional water and macroinvertebrates samples were collected at SDRAP03 and SDRAP14.



Figure 10. Map of a portion of western North America showing sites where *D. geminata* has been reported from EMAP, NAWQA, state agencies, and other collections.



Figure 1. *Didymosphenia geminata*, under the light microscope. Sample from Boulder Creek CO, August 2004. Cell is approx. 120 microns in length.



Figure 4. In the absence of scouring flows, patches of *D. geminata* merge to form continuous coverage on the stream substrate. Rapid Creek SD, April 2005.



Figure 6. Living cells (red arrow) and clear stalks are shown under the light microscope. The amount of stalk material may be much greater than the biomass of diatom cells. The stalks also trap fine sediment (blue arrow).



Figure 2. *Didymosphenia geminata* in the initial stage of growth. "Tufts" of stalked clones in Rapid Creek SD, April 2005.



Figure 5. As cells continue to grow and secrete copious mucopolysaccharide stalks, masses become stringy and may be dislodged and swept downstream. The masses accumulate on woody debris and rocks. Rapid Creek, SD April 2005



Figure 7. Stalks persist on substrates for 1-3 months following the death of cells. A matrix of mucopolysaccharide and fine sediment is shown on Boulder Creek CO, August 2004. This organism has effects on the ecosystem beyond the lifetime of individual cells.

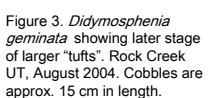


Figure 3. *Didymosphenia geminata* showing later stage of larger "tufts". Rock Creek UT, August 2004. Cobbles are approx. 15 cm in length.

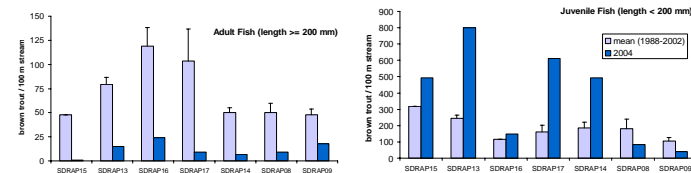


Figure 8. Plots of the estimated number of brown trout in Rapid Creek for the years 1998-2002 and 2004.

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